Physics 250: Computational Physics

Instructor: David W. Miller, PRC 245,
773-702-7671, David.W.Miller@uchicago.edu

Lecture Times:	Tue–Thur 2:00pm–3:20pm
Lecture Location:	KPTC 309 (Kersten Physics Teaching Center)
Textbook:	None required, many suggested! (see Reading List)
Canvas Course Site:	https://canvas.uchicago.edu/courses/16987
Course GitHub Site:	https://github.com/UChicagoPhysics/PHYS250
Course JupyterLab:	https://ml.maniac.uchicago.edu/index.html
Piazza Site:	https://piazza.com/uchicago/fall2018/phys250
Prof. Office Hours:	Tue. 3:30pm–4:30pm, and by appt.
Computer Lab Hours:	Help is available specifically for PHYS 250 by TAs in the Computer Science Instructional Lab (CSIL), 1st floor of Crerar, on: Tue 7:00-9:00 pm in CSIL 1 Wed 2:30-4:00 pm in CSIL 2 Wed 7:00-9:00 pm in CSIL 1
Teaching Assistants:	See the *Additional Information* section.
Description:	Introduces the use of computers in physics. After an introduction to programming basics, we will cover numerical solutions to fundamental problems, techniques for manipulating large data sets, neural networks, and basic data analysis.
Homework (70%):	Homework & materials available on Canvas and GitHub. ***Due Date:*** **Thursdays**. Graded homework will returned the following week. ***Collaboration Policy:*** Collaboration on issues, concepts, and approaches is encouraged, but the work *must be your own.*
Final Project (30%):	Dec 7, 2018 (Reading Period). Poster presentation on approved topics (topic approval due Nov. 6). Reviewed by judges panel, final grade by instructor.

Tentative Course Outline:

The weekly coverage is subject to changes and adjustments as the course progresses.

Week	Week Of	Lecture Topics, Exams, Information
Week 1: Lec 1–2	Mon Oct 1	• Algorithmic thinking, programming structures • Python, Jupyter, Unix, shell, git • **Relevant reading:** KN 1.1; LPB 1.5, 5.2,
Week 2: Lec 3–4	Mon Oct 8	• Software design concepts, visualization • Random number generators, errors • **Relevant reading:** KN 6.2; LPB 2.1
Week 3: Lec 5–6	Mon Oct 15	• Ising model, Metropolis algorithm • **Relevant reading:** Sethna 8.1; KN 6.4; LPB 15.1-15.4
Week 4: Lec 7–8	Mon Oct 22	• Minimization and the Monte Carlo method • **Relevant reading:** Franklin 12.1-12.6
Week 5: Lec 9–10	Mon Oct 29	• Ordinary differential equations • **Relevant reading:** Franklin 2.1-2.6; KN 6.8; LPB 7.1-7.10, 9.1-9.8
Week 6: Lec 11–12	Mon Nov 5	• Partial differential equations • **Relevant reading:** Franklin 4.1-4.4; LPB 17.1-17.19
Week 7: Lec 13–14	Mon Nov 12	• Fourier transforms • Data analysis techniques • **Relevant reading:** Franklin 7.1-7.7; KN 4.1-4.3; LPB 10.1-10.10
Week 8: Lec 15	Mon Nov 19	• **Holiday:** Thanksgiving, Thursday Nov 22 • Data analysis techniques • **Relevant reading:** KN 4.1-4.3, 8.2
Week 9: Lec 16–17	Mon Nov 26	• Neural networks • **Relevant reading:** Franklin 14.1-14.6
Week 10: Lec 18	Mon Dec 3	• Invited speaker
Reading Period	Fri Dec 7	• Final project poster presentations • KPTC 206 (Lounge)

Recommended References:

- Press, *Numerical recipes : the art of scientific computing*
  - `QA297.N866 2007`
  - available in a limited form online here
  - python resources & exercises here
- Sethna, *Statistical Mechanics: Entropy, Order Parameters, and Complexity*
  - `QC174.8.S48 2006eb`
  - available as a PDF here
  - computational resources & exercises here
- Kinder & Nelson (KN), *A Student's Guide to Python for Physical Modeling*
  - ISBN: 9781400889426
  - computational resources & exercises here
- Franklin, *Computational Methods for Physics*
  - ISBN: 9781139525398
  - computational resources & exercises here
- Landau, Paez, Bordeianu (LPB), *Computational Physics, Problem Solving with Python*
  - `QC20.82.L36 2007`
  - computational resources & exercises here
  - The text book in the Library is actually, *Computational Physics, Problem Solving with Computers (2nd Ed.)* but the updated online version is more useful, I think
- Halterman, *Fundamentals of C++ Programming*
  - available as a PDF here
  - computational resources & exercises here

Supplementary Math Texts (can be helpful for algorithms):

- Arfken & Weber, *Mathematical Methods for Physicists* `QA37.2.A740 1995`
- Greenberg, *Advanced Engineering Mathematics* `TA330.G725 1998`

Additional Information for the Course:

Teaching Assistants (TA):

TA's will have office hours as well as be available in the CSIL lab for assistance.

TA Name	Email	Office Hours	CSIL Lab
Takumi Matsuzawa	tmatsuzawa@uchicago.edu	TUE 7:00-9:00 pm	CSIL 1
John Parker	japarker@uchicago.edu	WED 2:30-4:00 pm	CSIL 2
John Parker	japarker@uchicago.edu	WED 7:00-9:00 pm	CSIL 1

Schedule and Section Assignment Information:

- CSIL Lab Sections will begin meeting in Week 2 of Spring Quarter.

Piazza

This term we will be using **Piazza** for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself.

- Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.
- If you have any problems or feedback, email myself or the Piazza developers: team@piazza.com
- Find our class page at: https://piazza.com/uchicago/fall2018/phys250